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ABSTRACT

A research and development effort undertaken to test the hypothesis that concept-learning techniques should be used to teach sophisticated vocabulary concepts is described in this report. The first section provides background information. Specifically, it reviews the need for and the current state of vocabulary development instruction; delineates the constituents of the vocabulary development process, focusing on the interrelationship of vocabulary acquisition and concept acquisition; relates general guidelines for and precautions about concept-learning strategies provided by the literature; and discusses subject-area terminology as the vocabulary development content selected for experimental application of such strategies. The second section describes the procedures followed in developing prototype materials, delineates the guidelines synthesized for developing these materials, and provides selections from the materials produced. The third section discusses the field testing of the materials and relates observations made about the assessments and the lessons. The final section summarizes the research and development efforts, states conclusions about the study, and explores implications for the future development of other such concept-learning materials designed to facilitate vocabulary development. (FL)

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THE USE OF CONCEPT-LEARNING TECHNIQUES IN VOCABULARY DEVELOPMENT INSTRUCTION

Ann Humes

ABSTRACT

A research and development effort was undertaken to test the hypothesis that concept-learning techniques should be used to teach sophisticated vocabulary concepts. The literature was surveyed for background information on the current state of vocabulary instruction, on the constituents of the vocabulary development process as they relate to concept acquisition, and on the appropriate methods and content for the application of concept-learning techniques. Definitions relevant to concept learning were determined, and content items were organized and processed. Specific procedures for instruction and practice were synthesized from the literature's general guidelines. Materials were then developed to implement these procedures, and these materials were field tested. Observations were made about the effectiveness of these materials, and positive answers were provided to the two field-test questions concerning whether subject-area vocabulary can be taught separately from the teaching of subject-area content and whether precepts from research in concept learning can be used in vocabulary instruction.

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THE USE OF CONCEPT-LEARNING TECHNIQUES IN VOCABULARY DEVELOPMENT INSTRUCTION

Ann Humes

A need currently exists for instruction that will enhance vocabulary development, and concept-learning strategies are frequently cited as the appropriate instructional techniques to ameliorate this need. However, prototypes pose a problem. In 1964, Carroll lamented the lack of adequate models for construction of appropriate concept-learning instruction designed to improve students' vocabulary knowledge. In 1977, complete and satisfactory prototypes still do not exist; prototypes of concept-learning instruction generally deal with limited concepts at primary levels and usually involve concrete objects or geometric shapes that are easily manipulated. Such strategies are not sufficient for teaching sophisticated vocabulary concepts.

Since the real test of educational theory is in its practical application, innovative instructional models that incorporate concept-learning strategies must be generated and then tested. Such a study was recently conducted. In this study, concept-learning research was applied to the development of instructional materials designed to enhance vocabulary development. Then these prototype materials were field tested at several grade levels in public schools to determine their efficacy in promoting vocabulary development.

This paper documents this research and development effort. The first section of this paper provides background information; it (1) reviews the need for and the current state of vocabulary development instruction that motivated this study, (2) delineates the constituents of the vocabulary development process, focusing on the interrelationship

of vocabulary acquisition and concept acquisition, (3) relates general guidelines for and precautions about concept-learning strategies provided by the literature, and (4) discusses subject-area terminology as the vocabulary development content selected for experimental application of such strategies. The second section of this paper describes the procedures followed prerequisite to developing prototype materials and delineates the guidelines synthesized for developing these materials. The guidelines for instruction and practice are exemplified with selections of the materials produced. The third section discusses the field testing of the materials and observations made about the assessments and the lessons. The final section summarizes the research and development efforts, states conclusions about the study, and explores implications for the future development of other such concept-learning materials designed to facilitate vocabulary development.

BACKGROUND INFORMATION

The Need for and Current State of Vocabulary Development Instruction

The need for and current state of vocabulary development instruction motivate this research and development effort. To say that vocabulary knowledge is necessary for the successful accomplishment of language-related activities is axiomatic. Knowledge of word meaning is prerequisite to the comprehension of spoken language through listening. Correspondingly, knowledge of word meaning is one of the most important factors in the comprehension of reading texts. Skilled speaking is dependent upon the ability to use appropriate words. Similarly, skilled writing requires a large fund of words to accommodate selection of the most appropriate term for expressing a desired meaning.

Although these relationships are necessary for language competence, considerable evidence indicates that not all of them are being adequately fostered (Humes, 1976b; Petty, Harold, and Stoll, 1967). Inadequate vocabulary development is responsible for many problems of learning and communication competence (Dale, 1965; Conference on Reading Studies 1, 1975; Carroll, 1969). Vocabulary deficiencies affect comprehension of sentence difficulty (MacGinitie, 1976), language achievement scores (Aulls, 1970), I.Q. results (Conference on Reading Studies 1, 1975), reading speed (Jenkinson, 1973), and, ultimately, subject-area test scores and grades (Ayers, 1965). When students leave school, inadequate vocabulary in both the receptive and productive modes has a negative effect on their vocational success (Petty, et al., 1967). Explicit vocabulary instruction appears to ameliorate these problems (Blair, 1941; Bradley, Cahill, and Tate, 1941; Draper and Moeller, 1971; Thompson, 1973).

Numerous other studies and surveys also verify the need for and importance of instruction to enhance vocabulary development (e.g., Dunkel, 1944; Khan, 1972; Humes, 1976a). Despite the obvious need, vocabulary development technology is at a nearly primitive level, for most of the valid information on vocabulary development techniques remains in the domain of research rather than application (Petty, et al., 1967). Traditional classroom instruction in vocabulary still frequently involves (1) looking up lists of words in dictionaries, (2) writing sentences incorporating the words, and (3) testing (Draper and Moeller,

1971). Often a particular technique employed is based on hearsay and intuition rather than on valid research knowledge (Holley, 1971; Petty, et al., 1967).

Thus the importance and lack of valid and systematic instructional materials to facilitate vocabulary development is confirmed by the literature. This insufficiency concomitantly confirms the need for devising discrete, research-based instructional techniques that will provide pertinent teacher information and appropriate student materials that can enhance the constituents of the vocabulary development process.

Constituents of the Vocabulary Development Process

Before the requirements for appropriate instructional techniques were determined, the vocabulary development process was investigated to ascertain its constituents. For current purposes, the term "vocabulary development" labels the process by which individuals acquire vocabulary knowledge and vocabulary usage skills. (Vocabulary development techniques are the procedures employed by instructors to facilitate their students' vocabulary development processes.) According to most authorities, important constituents of the vocabulary development process include the acquisition of skills that enable students (1) to decode meaning from words and groups and words and (2) to encode meaningful verbal communications into words from knowledge of word meaning.

Decoding words involves skills in the analysis of the components of an individual word or group of words. It also entails skills in the analysis of a word's environmental context for various clues to meaning which that environment may provide. The contextual environment may be heard or read; i.e., decoding occurs in the receptive modes of language. Encoding words entails producing the applicable labels (word parts, a word, a group of words) required to symbolize or translate meaning into the productive modes of language--for speaking and writing.

These encoding and decoding skills are necessary to function at various levels of word-meaning skills. According to Cronbach (1942) there are five such levels:

(1) generalization--the person can define the word;

(2) application--the person can recognize an appropriate illustration of the word;

(3) breadth of meaning--the person can recall different meanings for a word and knows when its use is appropriate in a particular context;

(4) precision--the person can apply the term correctly in all possible situations, even unfamiliar ones;

(5) availability--the person can use the term in thinking and in discourse.

To function successfully at these five levels of word meaning, a student must have or must acquire knowledge of the meanings for which the words are labels. The acquisition of meaning knowledge is dependent upon the prerequisite or concurrent development of concepts and concomitant categories of concepts. Thus many authorities agree that the process of vocabulary development is related to the process of concept development

(e.g., Kessler, 1976; Marks, 1976; O'Rourke, 1974; Russell, 1954). O'Rourke (1974) explicitly states that "meaningful vocabulary building is concept building" (p. 36).

Carroll (1964) first described vocabulary development as concept development. He asserts that a word is a societally standardized concept: "There is some sort of reinforcing condition that brands a word as being associated with a given concept" (p. 186).

Klausmeier, Ghatala, and Frayer (1974) state that knowing a concept's label (a word or group of words) renders that concept increasingly "facilitative" and that concepts are organized and accessed through supraordinate and subordinate classes of taxonomic systems (p. 163). These taxonomic systems are the basis for the viewpoint that vocabulary development is the acquisition of classifications of concepts, a position clearly delineated by O'Rourke (1974). O'Rourke sees vocabulary development as a system of acquisition of structures that enable learners to see words as classified components of a synergistic whole--it becomes a filing process of classifying and ordering concepts. Classification allows contexts to build up around the word.[1]

O'Rourke's view of vocabulary development as acquisition of categories of concepts is strongly influenced by Lenneberg's (1967) work on the biological foundations of language development. Lenneberg feels that

---

[1]Classification accounts for dimensional change in an individual's definition of a word, an aspect of vocabulary development. Research confirms this dimensional change with experience and age (Dillon, 1976; Evanechko and Maquire, 1972).

"the cognitive function underlying language consists of an adaptation of a ubiquitous process (among vertebrates) of categorization and extraction of similarities" (p. 374). This process characterizes concept learning.

Thus the investigation of the vocabulary development process reveals a consensus that the process of vocabulary development is the process of acquiring vocabulary skills and knowledge, irretrievably intertwined with the acquisition of concepts themselves and their associated classifications. Recognition of this interrelationship predicated the decision to incorporate concept-learning strategies into instructional materials designed to enhance vocabulary development.

General Guidelines from the Literature

The literature was reviewed for information relative to developing concept-learning instruction, but most available studies deal with concept learning that occurs through experience with objects rather than through linguistic experience. Some studies suggest the potential effectiveness of linguistic cues and confirm the positive relationship between methods for language acquisition and concept acquisition (e.g., Johnson and O'Reilly, 1964; Lieberman, 1967).

The concept-acquisition process itself is detailed by numerous authorities (e.g., Bruner, Goodnow, and Austen, 1956; Bruner, Olver, Greenfield, et al., 1966; Klausmeier and Harris, 1966). Carroll (1964), Clark (1971), Klausmeier et al. (1974), Markle (1975), Martorella (1972), and Anderson (1972; with Kulhavy, 1972) are some of the researchers who discuss using concept-learning techniques to facilitate vocabulary

development. But most authorities get no more explicit than to suggest a deductive procedure that entails a definition emphasizing the critical attributes followed by a presentation of instances and non-instances of the concept.

Clark (1971) does provide some criteria for understanding the procedures and devising concept-learning technology. He first enumerates the differences between learning concepts in the research situation and learning them in the classroom. He then articulates important considerations in teaching concepts and notes procedures for classroom implementation of concept-learning techniques, although these techniques are more appropriate for concepts such as geometric shapes than they are for vocabulary concepts. Sequencing is another crucial consideration, and Carroll (1964) offers some broad guidelines for sequencing; they pertain to the number and saliency of the attributes and the relation of negative to positive instances.

However, the literature generally posits more precautions than practicable principles. Carroll (1964) warns that a formal definition for a term will be successful only if it correctly identifies and describes all the relevant critical attributes and communicates their proper relationships. Markle (1975) criticizes the majority of concept presentations as inadequate and inappropriate and cautions that the "definition should bear some clear relationship to the domain of the concept, where 'domain' means the range of examples that are to be included and the limits of the domain that separate examples from non-examples...the definition must map clearly onto the domain" (p. 3).

She adds this admonishment:

> A second requirement is appropriate exemplification. Complex concepts require a complex set of examples, generated according to known rules. Conceptual instruction will dip into the nonexample realm as well. (p. 3)

She further warns that problems could arise from providing faulty exemplifiers for the definition or from using excess prose and technical or overly literate terminology.

Markle also cautions against instruction that does not take into consideration important underlying classification schemes. According to O'Rourke (1974), such categorization must be utilized as an operational technique that facilitates vocabulary development by classifying concepts in a meaningful way for presentation.

The literature thus contributes some general guidelines for the implementation of various concept-learning techniques and strategies from which specific procedures can be synthesized. However, before instruction incorporating these procedures can be developed, it is necessary to identify vocabulary content appropriate for concept-learning techniques.

Subject-Area Terminology as the Test Case

The literature warns that not all vocabulary learning entails concept learning. For example, Markle (1975) denies that acquisition of new labels (words) for a previously acquired meaning is concept learning: "Another standard technique to be elminated from concept teaching...is definition by synonym....Much of vocabulary instruction in one's own language boils down to acquiring a new, and usually longer

and more prestigious, noise to be emitted in response to a category that one has already mastered. Thus, one learns that 'to circumvent a difficulty' means to 'get around a difficulty'....However, in the sense of having mastered a new classification scheme which was not previously in the repertoire, the learner has made no progress" (p. 6).

While authorities such as Markle may refute synonym teaching as concept learning, the acquisition of concepts is required for other aspects of vocabulary development. Russell (1954) asserts that teaching subject-area vocabulary should be accomplished through concept-learning techniques.

Subject-area terminology is a crucial aspect of vocabulary development. However, technical vocabulary is usually treated solely within the instructional domain of the particular subject area, if it is taught at all. Yet prolific vocabulary development is essential for subject-area study: Students are expected to acquire a working vocabulary of terms that become prerequisite to learning and using new concepts in subsequent instruction--in subject areas, new vocabulary concepts build on previously learned vocabulary concepts.

Most authorities affirm the importance of vocabulary development in the subject areas. Knowledge of technical vocabulary is often the key to communicating basic ideas in the subject (Barbe, 1961; Block, 1976; Conference on Reading Studies 5, 1975; Cronbach, 1943; Klausmeier et al., 1974; Jenkinson, 1973). Dale (1965) requests less concern over total vocabularies and more study of special vocabularies in various fields.

Expressing concern because vocabulary acquires special importance beginning in about the fourth grade, Draper and Moeller (1971) contend

that when students get into subject-matter texts, a limited vocabulary begins to hinder them because textbooks in science, health, social studies, and mathematics become increasingly expository, using vocabulary that is progressively different from the vocabulary of the reading texts.

Research studies on subject-area vocabulary verify that technical language is a problem and special instruction may be beneficial (e.g., Olander and Ehmer, 1971; Russell, 1954). When Aiken (1972) reviewed studies pertaining to the effects of language on mathematics, he repeatedly found that comprehension of technical vocabulary was a significant factor. One study Aiken cites investigated the effects of two different methods of teaching math, one of which involved language teaching. The experimental group was taught by an English teacher with training in teaching reading but not experienced in teaching math; the control group was instructed by an experienced math teacher. The major difference between the two instructional methods was that the English teacher's procedure stressed understanding the meaning of words in math problems. The experimental group's performance was superior to the control group's performance on the criterion test in math even when initial differences in reading and math test scores were statistically controlled, thus verifying the importance of learning vocabulary concepts.

Since students frequently do not have this important working knowledge of technical, concept-building terminology that the literature indicates is prerequisite to learning concepts in various disciplines, concept-learning instruction designed to provide explicit knowledge of and experience in using subject-area terminology is important. It can

eliminate some of the language barriers to future learning. Because the need was found to exist and because teaching subject-area vocabulary is amenable to the application of concept-learning strategies, this content area was selected for incorporation into prototype materials.

DEVELOPING PROTOTYPE INSTRUCTION

Several procedures preceded construction of materials. Definitions were synthesized from the literature. Then subject-area terms were organized and processed for use in the instruction. Procedures for instruction and practice were also synthesized from the literature's precepts and precautions, and then prototype materials were developed according to these guidelines.

Definitions

A preliminary procedure involved determining an operational definition of "concept." A concept is defined by Carroll (1964) as the "abstracted and often cognitively structured classes of 'mental' experiences learned by organisms in the course of their life histories." Quillen and Hanna's (1961) definition is similar: "A concept is a general idea, usually expressed by a word, which represents a class or group of things or actions having certain characteristics in common."

For the current study, "concept" was defined as a unique and labeled set of related critical attributes. Concepts analyzed for instruction fit this definition and reflect the six characteristics of concepts noted by Frayer (1970):

1. properties common to all cases of the concept
2. the concept rule

3. properties that are irrelevant to the concept or which vary from case to case
4. a concept word
5. superordinate concepts
6. subordinate concepts

Types of concepts are variously labeled. Bruner et al. (1956) divide concepts into three major classes: conjunctive, disjunctive, and relational. These three categories are most frequently cited as the significant divisions of concepts and, consequently, were selected as divisions for the content. For purposes of this study, conjunctive concepts are those in which a set of common attributes describes the concept--certain attributes co-occur. Disjunctive concepts are those in which either one or the other of two or more attributes or sets of attributes describes the concepts--they have alternate attributes. Relational concepts are those in which a relationship between two or more attributes describes the concept.

Some researchers support a more complex categorization of concepts. Bourne (1970) divides concepts into the following "binary partitions": affirmative, conjunctive, inclusive disjunctive, conditional, biconditional, negation, alternative denial, joint denial, exclusion, exclusive disjunctive. Of these concepts, biconditional composes the only category referred to frequently in the literature beyond the basic conjunctive, disjunctive, and relational categories. Therefore, a biconditional category was included for this study, although no terms taught in the instruction were classified as biconditional. Biconditional is here posited as a category of concepts

that can be illustrated as "if this, then also this." This statement may also be cast in the negative for either half of the proposition.

Additional definitions relevant to concept-learning instruction are used in describing the development of the instructional prototypes:

1. critical attribute--a necessary characteristic of a concept
2. noncritical attribute--an unnecessary characteristic of a given concept
3. (positive) example--an example which has all the critical attributes of a concept in their appropriate relationship (An example may be referred to as an instance.)
4. non-example--an example which has (a) none or some, but not all of the critical attributes in their appropriate or inappropriate relationship, or (b) all the critical attributes, but not in the appropriate relationship (A non-example may be referred to as a negative example or a non-instance.)

Organizing and Processing

After definitions had been devised, a set of terms had to be selected from subject areas taught in elementary schools. SWRL has a current technical lexicon for each of the following disciplines: math, science, art, music, social science, and communication skills (Rhode, 1974). The lexicon sampled for this study was the social science lexicon.

An appropriate classification of superordinate and subordinate concepts had to be constructed. Therefore, all terms in the social science lexicon were first organized by the grade level at which a term appears in student materials.[2] Then third-grade terms were selected for

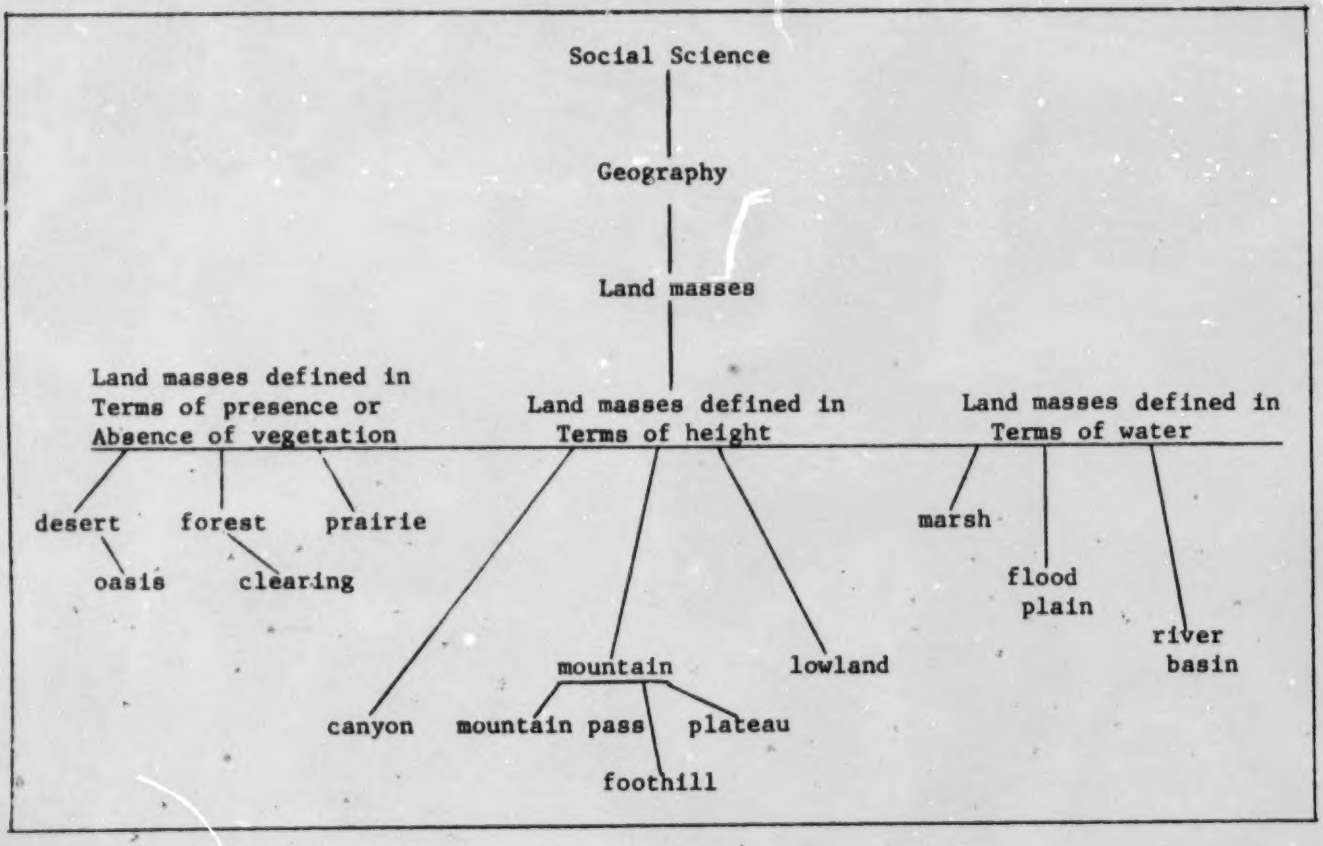
[2]Terms are designated in the technical lexicon as teacher or student terms. An analysis of the sequential appearance of the terms revealed that an item noted as a term in teacher materials in one grade level would appear one to three grades later in the student materials. Consequently, terms appearing in teacher materials at fifth and sixth grade levels, but not appearing in the student materials, can be sequenced at the seventh and eighth-grade levels.

further sorting and processing. Unnecessary terms falling into any of the categories noted below were deleted:

a. words that are in general use with approximately the same meaning as in the subject area
b. words that are more technical in another subject area
c. words that are also found in the SWRL entry lexicon (Rhode, 1972) with the same general meaning (even if technical use may require more precise specifications)
d. affixed forms of words found in the entry lexicon when the affix does not make a significant semantic change
e. words the use of which is unclear or vague in the subject area
f. proper names (in general)

Two sub-areas of third-grade terms, geography and economics, were then selected for futher analysis in preparation for writing instruction. One reason for choosing these areas is that terms from geography are frequently concrete, while terms for economics are generally abstract, and such divergent types of terms could provide a greater range of information from field testing. The sub-area terms were then analyzed for possible further classification. This analysis involved graphing the relationships between superordinate and subordinate classifications of terms. This graphing is illustrated in Table 1 by the graph for geography.

Table 1: Superordinate and Subordinate Categories of Vocabulary Terms



From the resulting classifications of concepts, the following terms were chosen for geography and for economics.

Geography	Economics
desert	economics
oasis	market
forest	product
clearing	goods
prairie	wholesale
marsh	retail
flood plain	consumer
river basin	investment
	capital

The next processing step required checking reference sources and recording attributes of the meaning of each word. For geographical terms,

four sources were used: World Book Dictionary, a children's dictionary; Encyclopedia Brittanica; Webster's New World Dictionary; Dictionary of Geological Terms. Four sources were also used for economics terms: American Heritage Dictionary, A Dictionary of the Social Sciences, World Book Dictionary, and Webster's New World Dictionary.

These lists of attributes were then examined to determine which attributes are critical to the meaning of the term. A feature was considered a critical attribute if all the reference sources included it in either an explicit or a logically implied form (e.g., "has plants" implies "greenness" in an oasis). The critical attributes were further analyzed for the critical relationship between the attributes and accordingly labeled "conjunctive" or "relational." (No terms were classified as biconditional or disjunctive.) The critical attributes were translated into students' language in accordance with established criteria and word lists. Examples of this entire process are noted in Table 2 for geography and Table 3 for economics.

The terms were then organized according to difficulty level. Sequencing factors included (1) the kind of concept and (2) the number of attributes.[3] The terms from economics were all conjunctive concepts, so the mean number of critical attributes for a subordinate category was the primary consideration effecting the presentation order for that category. The terms from geography were mostly conjunctive, with two relational terms that were defined in terms of other economics terms; "oasis" and "clearing" are defined in terms of their relationship to "desert" and

[3]The difficulty ordering between biconditional and relational is somewhat "arbitrary." Authorities place biconditional and relational between conjunctive and disjunctive in order of difficulty.

Table 2: Example Analysis of Critical Attributes for Geography Terms

Term	World Book Dictionary	Encyclopedia Brittanica	Webster's	Geological Dictionary	Critical Attributes
Oasis (relational)	in the desert is fertile has water has plants	fertile tract of land in the desert supply of fresh water variable size	fertile or green in an arid region	fertile green tract of land in a waste or desert	1. land in the middle of a desert 2. fertile 3. green 4. water supply

Table 3: Example Analysis of Critical Attributes for Economics Terms

Term	American Heritage Dictionary	Social Sciences Dictionary	World Book Dictionary	New World Dictionary	Critical Attributes
economics (conjunctive concept)	social science that deals with the production, distribution, and consumption of commodities	study of human behavior relating to ends/means of markets, patterns of economic growth	science of how people produce goods and services and how to distribute them, use them deals with material welfare of mankind	science that deals with the production, distribution, and consumption of wealth and with the various related problems of labor, finance, taxation, etc.	1. science 2. deals with producing goods and services 3. deals with selling goods and services 4. deals with using goods and services

"forest." "Desert" and "forest" were ordered in the first lesson with those terms having the fewest critical attributes. Although authorities consider relational concepts more difficult than conjunctive concepts, the two relational concepts, oasis and clearing, came after the first subordinate set and preceded the final complex set of related conjunctive concepts because (1) one of the terms is quite simple when measured by number of attributes (only two), and (2) these terms could then immediately follow those terms by which they are defined (i.e., "desert" and "forest").

The final sequencing for both economics and geography is noted in Table 4.

Table 4: Sequencing of Terms

PRESENTATION SEQUENCE FOR UNIT ON GEOGRAPHY TERMS
Lesson 1: forest, prairie, desert
Lesson 2: clearing, oasis
Lesson 3: marsh, flood plain, river basin
PRESENTATION SEQUENCE FOR UNIT ON ECONOMICS TERMS
Lesson 1: goods, products, market, economics
Lesson 2: wholesale, retail, consumer
Lesson 3: investment, capital

Instruction

The following guidelines for instruction were devised from the synthesis of authoritative precepts and precautions found in the literature:

1. Inform students that they will learn a term (concept) and that they will be told the significant features to which they must be alert.

2. Give the complete definition (i.e., list of attributes) at the beginning, even if it is complex. The definition can then be divided into parts for instruction if necessary. Point out all the critical attributes and any non-critical attributes.

The following examples of instruction from geography and economics exemplify instructional guidelines 1 and 2.[4]

forest /fôr əst/

The first word is forest.
A forest is large and has many trees growing closely together. Each of these features is a part of the definition of forest:

1. It is large.
2. It has many trees.
3. The trees are close to each other.

[picture of forest]

Look at this picture of a forest with many trees close together.

The forest in this picture has plants growing under the trees. Plants may grow under the trees, but they are not one of the features that must be a part of a forest.

[4] The words "important feature" were used in the instruction because the words "critical attribute" do not satisfy the criteria for selecting language for student materials.

Two more words used in economics have to do with money. An investment is something money is spent on to be kept. It is expected to produce more money while it is kept. Each of these features is a part of the definition of investment /in vést mənt/:

1. It is something money is spent on.

2. It is kept. (It is not meant to be used or used up.)

3. It is expected to produce more money while it is kept.

For example, people may use money to make an investment in land when they buy the land. When the price of the land goes up, it can be sold to make more money. So land can be an investment.

Read the important features of the definition of investment again.

A "remember box" reviewed the critical attributes of the terms in each lesson before students practiced those terms. A "remember box" also preceded new instruction to remind students of the critical attributes of terms taught in the previous lesson.

Remember the important features of these words:

forest - large, many trees, close together
prairie - large, tall grass, few trees
desert - large, very dry land, few or no plants

Constraints of written instruction (as opposed to the manipulation of objects characteristic of most concept-learning situations) required that instructional guideline 3, relating to the presentation of examples and non-examples, be effected through practice rather than instruction:

3. Provide positive and negative examples. (Examples improve ability to generalize, while non-examples improve ability to discriminate.)[5]

   a. If possible, begin the instruction with an example free of non-critical attributes.

   b. Present an example which differs as much as possible in non-critical attributes, but matches on critical attributes.

   c. Present a matched example/non-example set that has the same non-critical attributes, but differs on one critical attribute.

   d. If the constraints of the concept permit, present enough examples and non-examples to conform to Markle's (1975) guidelines:

      1. The minimum number of examples used should be the number necessary to vary irrelevant attributes.

      2. The minimum number of non-examples should include a non-example for each relevant attribute.

   Thus a concept having three defining attributes and four irrelevant attributes should be taught through the use of four examples and three non-examples.

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[5]Generally ease of concept attainment increases as the proportion of positive instances increases. For conjunctive concepts, emphasis on a sequence of positive examples is effective. For disjunctive concepts, emphasis on a sequence of negative examples may be more facilitative than a sequence of positive examples.

e. Point out why the item is or is not an example of the concept by noting the presence or absence of the critical attributes.

Practice

Practice that facilitates learning concepts should conform to the types of activities listed in the following guidelines. The examples of student materials exemplified here fulfill these requirements as well as those previously noted concerning instruction (see point three of instruction).

1. Identifying examples and non-examples.

   a. Given a concept name, students choose a critical attribute.

Mark an X by the letter that correctly completes the sentence.

1. A desert is _____.

   _____ a. dry

   _____ b. wet

   _____ c. cold

   b. Given the attributes, students choose between concept/non-concept.

Read the following sentences. Mark an X by the letter for the correct answer.

1. Girls and boys like to play hide-and-seek in the tall grass and behind the many trees.

   _____ a. This is a prairie.

   _____ b. This is not a prairie

Criteria 3e above, under Instruction, stipulates, "Point out why the item is or is not an example by noting the presence or absence of the critical attributes." This was accomplished here through an Answer Key which students used to check their own papers:

> 1. b (This is not a prairie because there are many trees.)

c. Given the attributes, students choose between concepts.

> Read the following sentences. Mark an X by the letter for the correct answer.
>
> 1. They saw few plants and no animals in the large, dry area of land.
>
> _____ a. This is a forest.
>
> _____ b. This is a prairie.
>
> _____ c. This is a desert.

Again the Answer Key pointed out the presence or absence of critical attributes:

> 1. c (This is a desert because it is large and dry and has few plants.)

2. Verbalizing (e.g., writing) the concept name. Given the attributes, students name the concept. This is a constructed response extending across concepts. However, it may be limited to the concepts taught within a particular segment.

Read the following sentences. Write the correct word that completes each sentence. Use the following words: goods, product, market, economics, wholesale, retail, consumer, investment, capital.

1. Beth studied _____ so that she could learn about buying, selling, and producing goods.
2. She bought some land. She expected to sell it in a few years for a higher price than she had paid for it. The land was her _____.

3. Identifying and naming the critical attributes.

   a. Given the concept name and all but one attribute, students complete the attributes.

One of the important features is missing for each word. Write that feature.

desert

1. large
2. _____
3. few or no plants

   b. Given the concept name and some of the attributes (the number varies according to the complexity of the concept), students complete the remaining attributes.

Two of the important features are missing for each word. Write those features.

investment

1. _____
2. kept
3. _____

4. Defining the concept. Given the name of the concept, students list all the attributes.

Write all the important features for each word.

forest

1. _____

2. _____

3. _____

The above activities should be incrementally sequenced. Step 1a must always follow the instruction. The inclusion of steps 1b, 2, and 3 after a segment of instruction must be determined on the basis of the requirements of an individual segment. Step 4 should not be included until sufficient practice with steps 1-3 has been provided.

Items for 1-3 must be developed first by listing the critical and non-critical attributes, varying them according to the criteria noted under part 3 of the above section on instruction. After the attribute lists are completed, they may be cast into any of the following item stem types:

a. an attribute list: 1a, 1b, 2

b. a concept name: 4 (as illustrated)

c. an attribute list and a concept name: 3 (as illustrated)

d. pictures: 1-4

e. sentences: 1-4 (as illustrated under 1a, 1b, 1c, 2)

FIELD TESTING THE MATERIALS

A tryout of the concept-learning materials was undertaken for two purposes: (1) to determine whether subject-area vocabulary can be taught separately from the teaching of subject-area content, and (2) to determine whether precepts from research in concept learning can be used in vocabulary instruction. Twelve classes were used in the tryout, four at each of the following grade levels: 4, 6, 8. All 12 classes were in suburban Southern California schools in middle-income areas and were believed to reflect average ability levels for their schools. Pretests were administered before instruction began. These tests are discussed below with the description of the assessment.

Terms from geography were taught in all fourth-grade classes and in the sixth-grade classes of one school. Terms from economics were taught in all eighth-grade classes and in the sixth-grade classes of another school. The instruction and practice for both geography and economics encompassed four lessons each. Teachers distributed the lessons, and students read the instruction and completed the practice. Lessons 1-3 in each unit taught new terms. Lesson 4 in each unit had no new instruction; it consisted of both a brief review of the previous lesson's terms and practice on all the unit terms.

After students completed a four-lesson unit, the teacher administered four kinds of assessment to measure the four modes of vocabulary use. The first three assessments functioned as both pretests and posttests; however, the fourth assessment was only a posttest because of the need for individual administration. The four kinds of tests are as follows:

1. Written comprehension (reading): For geography, students selected the two correct critical attributes out of four

choices for each term. For economics, students selected, out of two or three choices, the word or phrase that described or was described by the term.

2. Written production (writing): For both geography and economics, students had to use the unit words to fill in the blanks in sentences. The words were listed on the page in the pretest, but removed from the test page for the posttest.
3. Oral comprehension (listening): The teacher read sentences containing the unit words. Students chose the correct answer from three alternatives.
4. Oral production: Working with pairs of students, the teacher alternated between students, asking questions for which one of the unit words was the correct response. Eight questions were used for each unit; consequently, each student responded to four items.

All completed tryout materials were returned to SWRL. The lesson sheets were analyzed for item and content difficulty. The assessments were scored by SWRL staff. Pretest and posttest scores for geography are noted in Table 5. Pretest and posttest scores for economics are noted in Table 6.

Comments on the Individual Tests

For the written comprehension assessment in both geography and economics, two items accounted for most of the errors, although the error rate was considerably lower for these items on the posttest than it was on the pretest (e.g., 63% on the pretest vs. 25% on the posttest).

Table 5: Scores for Geography Terms

School	Grade	Class	Written Comprehension			Written Production *			Oral Comprehension			Oral Production
			Pre-test	Post-test	Gain	Pre-test	Post-test	Gain	Pre-test	Post-test	Gain	
A	4		59%	87%	28%	36%	82%	46%	58%	80%	22%	95%
A	4-5		64%	86%	22%	46%	84%	38%	70%	78%	8%	71%
A	6	a	66%	89%	23%	53%	91%	38%	71%	86%	15%	82%
A	6	b	68%	90%	22%	44%	88%	44%	70%	84%	14%	92%
B	4	a	73%	89%	16%	34%	80%	46%	69%	82%	13%	83%
B	4	b	71%	91%	20%	37%	80%	43%	68%	86%	18%	80%

*On the Written Production posttest, the answer choices were removed, thus making the posttest more difficult than the pretest.

Table 6: Scores for Economics Terms

School	Grade	Class	Written Comprehension			Written Production *			Oral Comprehension			Oral Production
			Pre-test	Post-test	Gain	Pre-test	Post-test	Gain	Pre-test	Post-test	Gain	
C	6	a	54%	81%	27%	67%	78%	11%	69%	84%	15%	---
C	6	b	59%	91%	32%	56%	88%	32%	64%	94%	30%	87%
C	8	a	60%	88%	28%	82%	91%	9%	72%	93%	21%	---
C	8	b	66%	94%	28%	83%	81%	-2%	76%	95%	19%	91%
D	8	a	74%	96%	22%	83%	99%	16%	72%	96%	24%	97%
D	8	b	70%	86%	16%	75%	88%	13%	76%	91%	15%	68%

*On the Written Production posttest, the answer choices were removed, thus making the posttest more difficult than the pretest.

The increases in the scores for the written production are greater than raw scores indicate because the pretest provided alternatives from which to choose the correct answer, while the posttest provided no such choices; students had to generate the words themselves. Items with the highest error rate on the written production pretest again evidenced a significant decrease in that rate (e.g., 43% on the pretest vs. 8% on the posttest). Additionally, an error rate of 14% on one item may be attributed to the item's construction.

Since neither instruction nor practice was designed to enhance oral performance, lower increases for oral comprehension could be expected. While geography scores reflect this anticipated result, economics scores do not. Perhaps the abstract nature of the economics terms was a factor contributing to a higher gain in this task.

Comments on the Lessons

Analysis of the students' lesson sheets indicated that while the first appearance of some innovative formats caused some wrong marking, familiarity with these formats significantly reduced the number of student errors by the second appearance.

Concept sequencing may have caused some problems. The most difficult concepts were presented last in both the geography and economics units. Consequently, these concepts did not receive the same kind or amount of practice as the concepts presented earlier. The vocabulary concepts in the first two lessons of each unit were (1) presented, (2) practiced with the listing of attributes, (3) presented for practice in the next lesson with the critical attributes

noted in the "remember box," and then (4) practiced blind in a subsequent lesson. The blind practice allowed students to generate the attributes from memory and then check their answers against the Answer Key. If their answers were correct, the concepts were reinforced by those correct answers. If the answers were wrong, students could learn from their errors or omissions.

No such "blind" practice was provided for the concepts presented in the third lessons of each unit, since a "remember box" for their attributes introduced the final lesson in the unit. If the sequencing allowed for two or three simple concepts to be presented after the complex ones sequenced in lesson three, blind practice could then have been provided for those more difficult concepts. Analysis of the students' lessons confirm the need for such an ordering despite concept learning's stipulation that easier concepts must be sequenced before the more difficult ones.

Some students perceived the lesson sheets as tests. Instruction and practice may be more effective and appropriate if developers of materials alternate them more within the lesson rather than follow the standard procedure of first presenting all the instruction and then following it with all the practice. This approach would make lessons appear less like tests and would allow for the immediate and brief example/non-example practice that facilitates learning concepts.

SUMMARY AND CONCLUSIONS

A research and development study was undertaken to test, by practical application, the educational theory that concept-learning strategies can

enhance vocabulary development when these strategies are refined and incorporated into instructional materials. This study was motivated by a survey of the literature on vocabulary development that confirmed the importance yet lack of valid and systematic instructional materials to facilitate vocabulary development. This insufficiency concomitantly attested to the need for devising appropriate materials to enhance the vocabulary development process.

An examination of the literature revealed a consensus that the process of vocabulary development is the process of acquiring vocabulary skills and knowledge, which entails the acquisition of concepts themselves; thus concept-learning strategies should be incorporated into materials designed to facilitate vocabulary development. Some general guidelines for the implementation of various concept-learning techniques and procedures were contributed by the literature, and subject-area vocabulary was determined as a content area both amenable to and needing the application of these strategies.

Before prototype instruction was written, definitions relevant to concept-learning technology were synthesized from the literature, and subject-area terms were organized into superordinate and subordinate classifications. Then each term to be taught was subjected to concept-learning processing, which entails determining the term's critical attributes and their relationship, labeling the term for type of concept, and translating its critical attributes into students' language.

Specific procedures for instruction and practice were synthesized from the literature's general guidelines. Then innovative instruction

and practice were developed to implement those procedures. The instructional materials consisted of four lessons for each of two subject-area vocabulary units. These materials were then field tested by administering them to students in the fourth through eighth grades. Observations of these students' use of the materials provided insights about possible ways to improve the methods and materials.

From the field testing of this research and development effort investigating the practical application of the hypothesis that concept-learning techniques should be used to teach sophisticated vocabulary content, positive answers were provided to the two field-test questions:

(1) Subject-area vocabulary can be taught separately from the teaching of subject-area content. In fact, teacher response to these materials was quite favorable, with teachers expressing enthusiasm for more such relevant materials to teach vocabulary terms from other subject areas. The students themselves liked working with these materials despite the fact that a few formats may appear to some adults to be rather stark and "uninteresting." Future efforts should be directed to enlivening those formats while protecting the integrity of their concept-learning design.

(2) Using concept-learning strategies is a viable technique for effecting vocabulary development. The gains and class averages on the posttests affirm the ameliorative effects of concept-learning techniques on knowledge of technical terminology. However, the strategies usually employed in

concept-learning had to be modified to accommodate the requirements of instruction for vocabulary since these requirements are somewhat divergent from the requirements of teaching a physically manipulable "concept" such as a geometric figure. The prototype materials developed for this study and exemplified herein conform to the general prescriptions of current educational research on concept learning while incorporating the modifications appropriate and necessary for vocabulary instruction. They can form a basis for further research in this area.

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